NOTES ON THE OSTEOLOGY OF SINOPA, A PRIMITIVE MEMBER OF THE HYÆNODONTIDÆ.

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The following observations are based upon a nearly complete skeleton of a Middle Eocene creodont discovered by Mr. Walter Granger near Fort Bridger, Wyo., in 1902. The specimen is the property of the National Museum and the full description will be published under the auspices of that institution. I am indebted to the Secretary of the Smithsonian Institution for permission to publish this abstract in advance.

The skeleton is unusually well preserved, and practically complete except for the feet. Most of one fore and one hind foot are preserved, the others are missing. It is believed to be one of the most perfect skeletons ever found in this formation and is of interest as a typical generalized Creodont. The points of especial interest in its study were: (1) the relations of the Creodonta to marsupials and Insectivora, and (2) the relations of *Sinopa* to *Hyænodon* and to the Oxyænidæ.

Sinopa was the first fossil carnivore described from the Eocene of North America and is a characteristic genus of the Lower and Middle Eocene found in Europe as well as in this country. The dentition of this or allied genera has been well known from the descriptions of Cope and Scott, and Wortman in 1902 described a skull and some parts of the skeleton which he referred to *Sinopa*. The complete knowledge of the skeleton enables us to determine its relationships with certainty, and for the most part confirms the views hitherto generally accepted.

The animal was a little smaller than a coyote, but in proportions much more like the Tasmanian wolf, the lower limbs and feet being much shorter and less compact than in any of the Canidæ, and the tail long and heavy. The skull is long both in cranial and facial regions, the long basicranial region being very characteristic of carnivora, while in marsupials and insectivores the basicranial region is short. The mastoid has a small exposure on the side of the

skull, as in carnivora, while in marsupials and insectivores it has a large exposure on the back of the skull. The brain is very small and of inferior type, as in marsupials and all primitive mammals. The occipital and sagittal crests are high, as in the carnivorous marsupials. The tympanic bullæ are not preserved and probably were incompletely if at all ossified, and loosely attached to the skull as in marsupials and insectivores. In modern carnivora they are completely ossified and fast to the skull. But there is no trace in *Sinopa* of the supporting plates from the alisphenoid and basisphenoid bones around the margin of the bulla, the so-called "false bulla," which is more or less developed in most insectivora and marsupials. In *Hyænodon* the bullæ are ossified to a varying degree in the different species, in some apparently not at all, in others a loosely attached bony ring, in others again a complete osseous bulla; but there is no trace of false bulla.

The teeth resemble those of many carnivorous marsupials, the molars being triangular with transverse and oblique shearing edges; but the dental formula is that of eutherian mammals, three incisors, a canine, four premolars and three true molars, while the marsupials have four or five incisors, canine, three premolars and four true molars. The angle of the lower jaw is like that of typical carnivora, and shows no trace of the marsupial inflection. This inflected angle is seen quite as clearly in Cretaceous as in modern marsupials and is evidently a distinction of very ancient origin.

The details of construction of the skull, especially the basicranial bones and foramina, agree entirely with the true carnivora, and show that the marsupial resemblance is a superficial one.

The vertebræ agree with carnivora in all important points. The vertebral artery perforates the atlas and does not perforate the seventh cervical. This condition prevails in carnivora and most eutherians; in marsupials as far as I have examined, the reverse is the case.

There are 13 dorsals and 7 lumbars, making a dorsolumbar formula of *twenty* as in carnivora instead of *nineteen* as in marsupials. The dorsolumbar formula is known in only a few creodonts. In *Oxyæna*, and probably in *Patriofelis* and *Hyænodon*, it was twenty as in *Sinopa;* in *Dromocyon* nineteen according to Wortman. It is probable that in all Oxyænidæ and Hyænodontidæ it was twenty and in the Mesonychidæ nineteen, this family approaching the

marsupials in two or three other important characters, and differing rather widely from the remaining creodonta. The lumbar region is long and the vertebræ large with long transverse processes, indicating a flexible body with great leaping powers, as in primitive mammals generally. Among modern carnivora the cats, viverrines and mustelines retain more of this character than the other groups.

The limbs show a considerable degree of cursorial adaptation for an Eocene carnivore, the bones being longer and the feet more compact than in the majority of creodonts. The scapula is nearly as long and narrow as in the dogs (the anterior border is incomplete and is restored too wide in the mount); the humerus compares with that of the cat; the femur retains a vestigial third trochanter, but its distal end is deep and narrow, almost ungulate in type; the ulna is somewhat more robust than the radius, as in creodonts generally, and in most insectivora and marsupials; in modern carnivora the shaft of the ulna is reduced to a varying degree.

There are five well developed toes on each foot and the axis of symmetry in both fore and hind foot passes through the middle digit (mesaxonic) as in *Hyænodon*. In all modern carnivora and in the Mesonychidæ among creodonts, the axis of symmetry lies between the third and fourth digit (paraxonic). In the Oxyænidæ the weight is distributed over comparatively short spreading digits so that the axis of symmetry is not well defined (amphaxonic). The scaphoid, lunar and centrale bones of the wrist are separate as in creodonta, instead of united as in true carnivora; the arrangement of the carpals resembles that in *Hyænodon*, but their vertical diameters are greater. The fibula is large and has a considerable facet for the calcaneum, and the contact between astragalus and cuboid is slight as in *Hyænodon*.

The skeleton represents an undescribed species nearly allied to *S. rapax* Leidy. The skull described by Wortman as *Sinopa agilis* differs considerably in dentition, etc., and should be distinguished generically; the generic name *Prototomus* Cope, is probably available for this form. The most important distinctions from *Sinopa* in the teeth are the closely connate paracone and metacone on M^{1-2}, absence of metacone on M^{3}, reduced heels of the lower molars, and much compressed premolars.

In all respects *Sinopa* appears as a primitive member of the

Hyænodont phylum. The genera *Sinopa*, *Prototomus*, *Cynohyænodon*, *Pterodon* and *Hyænodon* show a series of stages in the development of a highly specialized sectorial dentition, and with some exceptions, in the specialization of the skull and skeleton so far as they are known. The geological occurrence of the known species of these genera precludes their being regarded as in the direct line of phyletic descent. *Sinopa* and *Prototomus* are found together in the Lower and Middle Eocene, while *Cynohyænodon*, *Pterodon* and *Hyænodon* occur together in the Oligocene. But without doubt the genera represent very closely the stages through which the phylum passed in its evolution, and that is about as much as it is safe to assert of most phylogenetic series.

The relationship of *Sinopa* to the Oxyænidæ, especially to *Limnocyon*, is not yet clear. There is a great deal of resemblance in skeletal characters, a marked diversity in the more significant features of the skull. Most of the resemblance, perhaps all, is to be explained as due to retention of primitive creodont characters, but some may indicate a nearer relationship of Hyænodonts to Oxyænids than to any other creodont family.